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14. ABSTRACT

The foundations for the Connecticut Center for Advanced Technology (CCAT) were created. Via collaboration between industry, government and academia, CCAT will strengthen US leadership in advanced propulsion and power systems and assure the global competitiveness of our nation's manufacturing supply chain. This program established a three part implementation path: First, the Advanced Technology Center will focus on key issues in propulsion and advanced power systems as well as take a leadership role in Next Generation Manufacturing technology. Second, the Connecticut Regional Innovation Center will provide the expertise and facilities for technology based new company formation. Third, the Center for Innovation and Enterprise Education will collaborate with regional education institutions to engage students and support the continuous learning of a world class work force. CCAT will be incorporated as a non-profit corporation and begin operation in rented office and laboratory space. The construction of it's future dedicated facilities will establish the core of a dynamic, global technology park, to be established at Rentschler Field, in East Hartford, Connecticut.

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Final Report

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Integrated Multi-Team Decision Making, Processes and Effectiveness

I. Objectives

The objectives of this work were focused in two main paths of activity. Combined, they represent a comprehensive program that spans both theory and practice.

First, the effort executed a comprehensive series of tasks which developed and demonstrated the principles of multi-team systems theory (MTST) of effectiveness. This activity included the establishment of research laboratories to empirically test aspects of MTST in a low-fidelity flight simulation environment. We also developed methods to assess a variety of influences on team and MTS effectiveness (e.g., environmental complexity, teammates' shared mental models), processes (e.g., strategy development, coordination) and outcomes (e.g., quantitative indices of mission effectiveness, members' reaction). We examined the impact of various interventions (e.g., team & MTS training, goal hierarchies, environmental complexity) on the processes underlying MTST.

Second, we sought to use a collaborative approach to address the critical issues facing our nation in both national defense and industrial, economic competitiveness. The outcome has been the establishment of the Connecticut Center for Advance Technology with its three key elements of Advanced Technology Center, Innovation Center and Center for Innovation and Enterprise Education.
The results of these initiatives are chronicled below.

II. Summary

We believe that our work has successfully accomplishing our original goals. Prior reports have described the results of the work on MTSs, while the current report will place greater focus on the development of the Connecticut Center for Advanced Technology.

MTS: Previously we had articulated the nature of Multi-Team Systems (MTS), developed a theoretical framework for studying them and established and refined a low-fidelity networked flight simulation research platform (ACES). We further developed and administered a grounded battery of individual difference measures to all participants in our empirical studies, and specified a taxonomy of team and MTS processes in a time-based framework along with a multi-dimensional and multi-method measurement battery for assessing them. Our empirical investigations have explored the impact of various team and MTS training programs, the role of environmental factors (e.g., variations in required cross-team coordination, complexity), and introduced feedback and AAR systems to enhance MTS effectiveness. This effort has produced several technical reports and journal articles which are in press or in the review process.

CCAT: The foundations for the Connecticut Center for Advanced Technology (CCAT) were created by this program. Via collaboration between industry, government and academia, CCAT will strengthen and support US leadership in advanced propulsion and power systems as well as assure the global competitiveness of our nation's manufacturing supply chain. This program established a three part implementation path: First, the formation of an Advanced Technology Center, which will focus on key issues in propulsion and advanced power systems as well as taking a leadership role in next generation manufacturing technology, including the use of lasers in manufacturing processes. Second, the creation of a Connecticut Regional Innovation Center which will provide the expertise and facilities to encourage new technology based company formation. Third, the establishment of the Center for Innovation and Enterprise Education which will collaborate with regional education institutions to assure the engagement of students and the continuous learning of a world class work force. CCAT has been incorporated as a non-profit corporation and will begin operation in rented office and laboratory space. Its future, dedicated

facilities will be targeted for location as the core for a regional technology park, to be established at Rentschler Field, in East Hartford, Connecticut.

III. Accomplishments in the Creation of the Connecticut Center for Advanced Technology (CCAT)

A. Determination of program focus

The CCAT assessment of regional capabilities and their relationship to national defense needs was initiated in a two pronged approach, as described in the following two sections. It included: (1) a local interactive activity based on interviews and discussions with stakeholder groups as well as (2). a "data mining" approach by external experts to provide an objective regional analysis. The key elements of focus were:

- Identifying key issues of national defense and economic security
- Identifying regional strengths and capabilities fundamental to these issues
- Awareness of those technologies and industrial sectors that are important to the future of defense and economic growth

1. Local Assessment

Using a cadre of regional technical experts, we engaged regional industry, universities and government agencies to identify regional strategic intent and capabilities. Stakeholders were identified and engaged in the following areas.

a. Advanced Propulsion and Power Systems

- Both gas turbine technology and fuel cell technology were underscored as key regional strengths with long standing national and world leadership. The industrial R&D capabilities in both are world class and the establishment of a Global Fuel Cell Center at the University of Connecticut provide basis for extensive systems performance capabilities.
- It was determined that the aerospace power systems industries are undergoing a significant transformation that encompasses a much stronger role for the extended supply chain. It is reasonable to expect that aerospace will arrive at the automotive industry norm of 80% of value being found in the various tiers of suppliers and the 20% remaining in the Original Equipment Manufacturers.
- A more detailed regional analysis was performed for fuel cell and ancillary clean energy industries to uncover the various levels of the "value chain".

b. Next Generation Manufacturing and Product Realization Supply Chain

Discussions with both large a small technology based companies in the region confirmed advanced manufacturing as being a core regional capability with global competitiveness issues of concern.

- The applications of new technologies, as well as the needs of workforce preparedness, were consistently indicated.
- Consistent with the emphasis on the transition of value into the supply chain, it was determined that collaboration and knowledge sharing among participants in this global supply network would be areas of key competitive focus.
- The technologies and business practices associated with Next Generation Manufacturing were identified as key
- An analysis, performed by the Center for Lean Business Management, pointed out the need for an expanded view for the implementation of lean practices that encompasses the entire supply chain.

c. Laser Applications

A strong regional capability in the development and application of lasers was identified as a world class capability that could be applied toward aerospace as well as commercial opportunities. The University of Hartford students and faculty participated in the development of an analysis of the regional and national capabilities in laser based processing to identify areas requiring further attention.

- Both joining and machining via lasers were found to be key to next generation propulsion systems development
- Laser based diagnostics and materials deposition is fundamental to the realization of advanced rapid product realization and repair capabilities.

d. Process and Durability/Reliability Modeling and Simulation

The regional aerospace industry possesses a unique, world class root cause understanding of design methods and manufacturing processes that result in reliable systems performance. This was identified as a core strength that can applied to a wider range of regional industries.

- Extensive modeling and simulation are key to codifying the effects of processes on performance and also the ability to control processes across the global supply chain

e. Biomedical device Applications

This was identified as an area of opportunity to expand current regional expertise and industrial capability for added value.

2. Battelle Regional Analysis

Battelle's Technology Partnership Practice group was engaged to conduct an analysis of the Connecticut region and identify regional strengths and strategic trends. Due to their experience and participation in many regional initiatives around the country, their involvement was deemed critical to gaining a more global perspective.

Their analysis was concluded in several briefings and the issuance of a final report entitled "Assessment of Opportunities for Technology Based Centers of Excellence in Connecticut" and consisted of two volumes

Vol 1: Analysis of Connecticut's Industry Base
Vol 2: Inventory of National Activities

The analysis of Connecticut's industrial base was helpful in providing confirmation that a multi pronged approach was needed to be successful in technology led initiatives in our region. It is insufficient to simply address technology issues without paying close attention as to how industrial entities can adopt the technology or create new enterprises which are needed to deliver the value of the technology to society.

The following key points were uncovered by the Battelle study.

- Connecticut's R&D strength lies in it's industrial base
  - CT is 12th in the nation in industrial R&D spending
  - 21st in University R&D
  - Industrial R&D is highest in propulsion/power systems/fuel cells
- Propulsion/Power Systems is the strongest industrial specialization in the region
- Innovation/entrepreneurship is occurring across multiple sectors (biotech, power, photonics, sensors/controls)
- Battelle recommended that CCAT's technology center initiative should be created in an interdisciplinary way such that it could benefit multiple business sectors. Next Generation Manufacturing was suggested to provide such a focus.

The Battelle analysis of Connecticut's industries is summarized in Figure 1 which provides an overview of the status of various industrial sectors. It is clear that the power and turbo machinery area provides a mature technology and intellectual industry base upon which to build. It also indicates that a number of smaller industrial sectors (notably, fuel cells, photonics, biotech, medical devices and sensors & controls), represent areas in which growth and capital investment are being made. They represent the areas for potential future technology led growth.

Industrial Sector	Regional Focus Relative to Nation	Employment 1998-2002	Patents 1997-2002	Investment Funding 1997-2002
Propulsion Turbomachinery	7.0	Decline	Strong	None
Industrial Machines	1.7	Stable	Moderate	Minimal
Advanced Materials	0.7	Stable	Moderate	Minimal
Fuel Cells & Batteries	1.7	Good growth	Moderate	Moderate
Photonics/ Lasers	1.9	Strong growth	Some	Strong
Biotech/Pharma	1.7	Moderate growth	Strong	Strong
Medical/ Devices	1.8	Good growth	Moderate	Moderate
Sensors & Instruments	1.6	Good growth	Strong	Minimal

Figure 1. Battelle analysis of regional industrial sectors

B. CCAT Structure and Major Initiatives

As a result of the above analyses we concluded that CCAT must establish the scope of its activities to embrace the total value chain of technology development and enterprise deployment. This is necessitated to insure the extension of capability from the mature regional industrial sectors into the newer, emerging industrial sectors having relevance to national needs. To this end we created a four fold approach which includes one organization, CCAT, that has under it three technology based activities.

- CCAT Organization: We have formed the basis to create a central, non-profit organization with rented offices and laboratory space in East Hartford, Connecticut that will operate via a core leadership staff, supported by a cadre of technology, business and education specialists. We have identified roles for federal, state and industrial sources of funding to construct dedicated facilities and provide long range sustained program execution.
- The Three technology focused activities are:
    - *Advanced Technology Center*: A Technology Center providing facilities for dedicated staff and partner organizations to focus on the transition of technology to meet national defense needs
    - *Regional Innovation Center*: A facility that supports and encourages the creation of new technology based companies
    - *Center for Innovation and Enterprise Education*: The stimulation of regional education institutions to establish innovative programs that engage students and strengthen the workforce.

1. Advanced Technology Center

As mentioned above, fact finding activities with local industry and academia were used to assess the regional capabilities and strategic directions that could benefit the nation's defense and form the basis for the formation of a Technology Center. As a result, specific strategies were created for going forward. This

culminated in the proposal to create an Advanced Technology Center (Figure 2) which brings together the following three key initiatives with a shared agenda of technology transition.

a. The National Center for Aerospace Leadership (NCAL)

The importance to the nation of Connecticut's regional strength in the industrial sectors of advanced power systems, with specific focus on propulsion and fuel cells clearly points to the need for a National Center to strengthen the capacity of the domestic aerospace industry to meet current and future US national security requirements. Specifically, we must:

- strengthen the effectiveness of OEM led distributed product development and manufacturing teams to produce best in world advanced military power and propulsion systems
- proactively enable an innovative, diverse and highly competitive domestic supplier base to provide the OEM's viable alternatives to the growing trend of global, "outsourcing"
- develop, support and maintain a domestic workforce that is world class in cost, capability and performance

The approach to this initiative will be to:

- Utilize Connecticut based engineering & manufacturing capabilities and DoD focused systems, critical to national defense, as platforms for execution in partnership with the national supplier base.
    - Advanced propulsion platforms and applications
    - Advanced fuel cells for distributed power, cogeneration, portable and transportation applications
    - Strengthen capability of 2nd and 3rd tier suppliers to meet OEM requirements for higher levels of product integration and associated engineering support
    - Advanced propulsion platforms and applications
- Enable more effective geographically distributed capabilities among diverse teams by incorporating intelligent tools into existing engineering and business processes.
    - Improve cost and risk management consequences resulting from increased engineering and subsystem content throughout the supply chain
    - Enhance total enterprise productivity
    - Increase competitive advantage through the adoption of transformational technology for both OEM's and a multi-tiered supply chain
- Enable Develop and validate intelligent computational modeling and simulation capabilities that:
    - Span dimensional and time scales controlling system performance
    - Enable root cause based control of key processes, including fabrication, service and repair in a global environment
- Integrate continuous and adaptive workforce education tools to attain and upgrade skills for improved effectiveness
    - Knowledge capture and utilization tools
    - Adaptive tools for life long learning
- Phased development of program structure and content
    - Define program structure (focus, stakeholders and roles, program management)
    - Conduct workshops to clarify stakeholder needs and desired outcomes
    - Define intelligent tools requirements and implementation paths
    - Engage other National Centers of Excellence to insure program success

b. Laser Applications Laboratory

The concept of a Laser Applications Laboratory, affiliated with the NCAL, was developed via both the above interest in advanced propulsion and the continuing interest in enabling manufacturing process technologies. The Connecticut region is home to several of the world's leaders in laser development and application. Coherent, Trumpf, Zygo, Prima, Xinetics, CiDRA as well as numerous smaller companies, are involved in the development or application of lasers. Several of these companies indicated a strong interest in forming a Laser Applications Laboratory in partnership with regional academic institutions. The overall

concept for the laboratory is based on the creation of a facility that will bring together three major technology foci:

- Laser equipment: Our regional companies have extensive expertise in the design and development of laser equipment.
- Surface engineering: The modification of surfaces or the deposition of coatings has broad applicability.
- Nanotechnology: New materials and processes that can be enabled via laser coupling with nanomaterials processing provides a basis for collaboration with regional nanotechnology initiatives. It can be noted that CCAT is providing sponsorship for a Connecticut Nanotechnology symposium to be held in October 2003, which will highlight the potential impact of nanotechnology in our region.

The Theme of Laser Based Manufacturing for Next Generation Propulsion and Power Systems is being used to integrate the capabilities of laser processing with the key needs of new propulsion systems including the processing of high temperature metallic and nonmetallic materials, the additive manufacturing of complex structures, surface treatment to enhance durability and the hole drilling in turbine airfoils.

c. Connecticut Center for Manufacturing Excellence

The above two initiatives should be augmented with the establishment of a third element that focuses on the current issues facing manufacturing suppliers. It should focus on regional companies and implement best lean enterprise practices as they pertain to not only internal operations of these companies, but also, how they can be employed in the extended supply chain.

A schematic which represents a shared facility for implementation is shown in Figure 2.

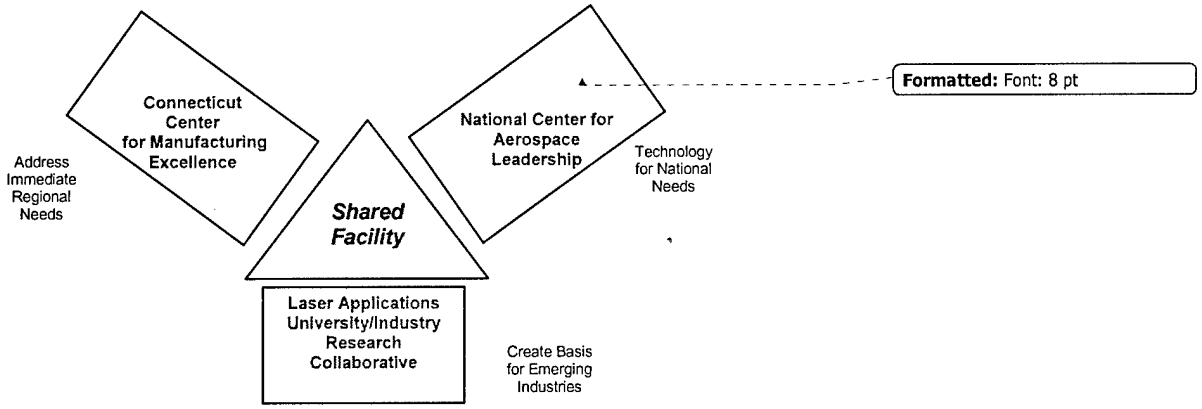

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Figure 2. Advanced Technology Center

2. Regional Innovation Center

To respond to the rapidly changing missions in our nation's defense, we must have a dynamic capability to deliver new technologies and capabilities. The effective creation of new enterprises is key to this agile transition and CCAT has determined that it needs to foster this process through the creation of a focus facility. To this end, the creation of a Regional Innovation Center has been made a high priority of our activities in order to foster innovation, entrepreneurship and new business creation as well as support and enhance the capabilities of current and emerging industries. These objectives are in support of the mission of the CCAT to "Inspire technology led economic development for the region through partnership with

industry, government and academia". While the underlying concepts for the Innovation Center were created under this program, its ultimate establishment will occur with regional economic development funds.

The Innovation Center intends to create an environment of innovation and enterprise. This combination is important and relevant to creating new products relevant to national defense and new markets and perhaps new industries to enhance the region's economic strength. The Innovation Center is envisioned to be a mixed use business incubator with office, laboratory and light manufacturing space and shared services to assist new companies in start-up. Additionally, it will serve the needs of small to medium sized companies seeking assistance with their innovation, technology transfer and product development processes. The Innovation Center will also serve as a place for companies from outside the region to locate in order to assess or access regional capabilities or markets. The ultimate purpose of this initiative is to support innovation and enterprise as a means to strengthen and broaden the state's economy.

a. Incubator Functions

- *Incubation of new companies*: A business incubator, as defined by the National Business Incubator Association (NBIA), "is an economic development tool designed to accelerate the growth and success of entrepreneurial companies through an array of business support resources and services". The goals of a business incubator are to produce successful firms that will leave the program financially viable, create jobs, commercialize critical new technologies and strengthen local and national economies.
- *Growth of existing companies*: While incubation is an important aspect of economic growth and diversity, it is a multi-year process at best. To bolster this element of technology led economic development, we intend allocating a limited amount of space to larger, existing enterprises to undertake their own innovative "entrepreneurial" efforts. The resulting incremental growth from one of these enterprises may have a larger, nearer term economic impact. Mixing the energy, enthusiasm and innovativeness of entrepreneurs starting their businesses with the process orientation and professional management of existing enterprises would enhance the capabilities of both. The entrepreneur would gain from the experience of more mature companies and the existing companies would value the creative energy of the new enterprises.
- *Attract new companies to the region:* Another aspect of the Innovation Center will be to attract organizations from outside the region to assess or access capabilities or markets. Our experience with industry is that companies often establish offices in locations around the globe where they wish to engage the region for either market or technological reasons. In most cases, they seek a location that is convenient, recognized as an important or prominent address or have other features which make it attractive. The Innovation Center will have space and resources available to attract and assist companies from outside the region to establish a base of operations or a "beachhead". Hartford's location as a mid-point between Boston and New York is appealing. The standard and cost of living in the surrounding communities are reasonable and somewhat discounted to either the Boston or New York metropolitan areas. Hartford also allows these companies to travel to either city for a meeting without requiring a flight or overnight stay while conducting daily operations in a lower cost, accessible, desirable location.
- *Education:* The Innovation Center will compliment the CCAT's education program by providing opportunities for internships and practicum. In coordination with the K-12 program, there is the possibility of setting aside some space and resource to enable students to start and run their own enterprise. Technical degrees as well as MBA programs usually require a practicum, internship or analysis of a real business or product issue. The Innovation Center will house several companies that could benefit from external, professionally guided assistance. Further, the tenants would have access to students and professors as potential employees or collaborators. Again, the element of innovation and enterprise are prevalent and essential to the success of the Innovation Center.

b. Phased Implementation Schedule

To achieve the greatest impact and earliest operation, the Innovation Center will be implemented in a two phased approach using regional economic development funding. Initially in Phase I, the Center will bring

together clients utilizing the client's existing facilities and operate in a virtual manner. Where needed, Center personnel will help clients identify appropriate space for lease. In the Phase II, a single facility that enables collocation is preferred in order to bring the clients together and operate in alignment with policies and procedures. In this final phase, a newly constructed iconic building will be built to serve as both an Incubator and also as the central element to the establishment of a Technology Park at Rentschler Field in East Hartford, Connecticut. This larger Tech Park will provide the region with the critical mass and resources for industrial growth needed to meet DoD's needs.

Our Phase I implementation stage is important to describe further. Through benchmarking other business incubators, we have noted that real estate often becomes the driving influence of the operation. Buildings are constructed or renovated which not only require early capital, but also must remain occupied in order to service debt. While our intent is to construct a building in order to precipitate further investment on the site and act as a catalyst for creating a technology park, it is important to pay as you grow. In the interim, we will establish and operate a virtual incubator and innovation center in facilities that are owned and leased by others who wish to work with us. In this manner, our operating expenses for the innovation center are off-set at break-even while construction is planned and executed.

A virtual center will challenge the concepts and operational procedures intended for the physical innovation center. The governance issues, added value of reviews, SBIR assistance, access to expertise and funding help resolve as well as selection and graduation criteria will be tested and modified as we gain experience managing the operation in dispersed locations. Our intent is to identify and lease space so that all clients could collocate in a single facility or campus. Some clients may wish to remain at their current facilities and continue to participate in a virtual manner.

c. Incubator network

To our knowledge there is not an active network of business incubators which exists to assess, share or access capabilities and markets. We believe that there are benefits to establishing a formalized network of business incubators with reciprocal agreements.
The agreement would enable a tenant meeting the acceptance criteria at one incubator to use the space and amenities at another incubator facility in the network. Most incubators offer many of the same services to their tenants. However, incubators cannot afford to replicate a unique piece of equipment or technology expertise. Additionally, a tenant could visit an incubator in another geographic or demographic region and temporarily inhabit space in order to tap into the host incubator's network, conduct market surveys or meet with prospective customers in the region.

The network in Figure 3 is an illustration of bringing together such a network in our region.

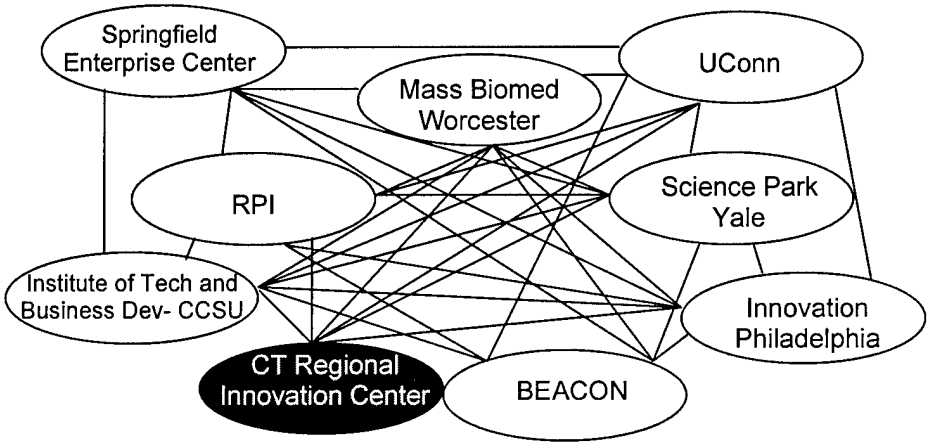

Figure 3. Incubator network for collaborative entrepreneurship

3. The Center for Innovation and Enterprise Education

CCAT has recognized the need to enhance the regional educational system to interest larger numbers of students in technology and to demonstrate new approaches to engage them in educational experiences which will prepare them for successful careers. We have identified the best educational practices that can be derived from both industry and educational institutions. We have engaged K-12 and community college faculty to identify opportunities that can be implemented using these practices. As a result we have provided assistance for the initiation of a program in regional middle schools and also have assisted in the development of a new manufacturing education initiative in community colleges.

a. Best practices

By engaging representatives of both industry and education institutions we identified four important categories of educational best practice.

- *Project-based:* The inclusion of projects that apply recently acquired knowledge reinforces both the educational experience and also provides demonstration of value in the knowledge acquired. Meaningful, real world projects that include hands on experiences and demonstrate the value of effective team based collaboration strengthen the relationship with ultimate career opportunities.
- *Blended learning*: The use of web based delivery of curriculum and the provision of tools for web based student/faculty and student/student collaboration enhance learner focused flexibility. This must be blended with periodic in person activities that provide hands on experiences and encourage interpersonal support and mentoring.
- *Interdisciplinary approach:* Ultimate success in industry and business requires the association of many different skills. Educational experiences which demonstrate the integration of math/science with business/enterprise will provide a basis for future career success.
- *Cultural Diversity:* The successful businesses fully embrace the reality of the globalization of markets, technology and the work force. Our region is fortunate in having a culturally diverse population and there is ample opportunity to encourage project based, multi-cultural collaboration.

b. K-12 Programs

We have developed a concept that demonstrates the above four principles in action in our regional schools. Science-ACT (Activism, Communications, and Technology) has been created as an interdisciplinary after-school enrichment program that engages students in hands-on scientific inquiry to address real-world problems of global warming. Students experience science as agents for social change and policy development, developing interdisciplinary skills in the areas of research, composition, persuasive writing,

scientific experimentation, and information technology. Using computer simulations and worldwide databases, students generate potential solutions to reduce our dependence on oil and will explore the effectiveness of alternative energy sources. Seventh- and eighth-grade students from diverse cultural, socioeconomic, and ethnic backgrounds come together to form teams to address renewable resources, evolutionary ecology, engineering, and economics and, acting as advocates, create web-based presentations of proposed resolutions to the global warming challenge.

Based on this concept, the State of Connecticut has chosen to implement a Science ACT pilot program at the Connecticut International Baccalaureate Academy in East Hartford, Connecticut using the academy's wireless network and video-conferencing capabilities. Between meetings, student teams collaborate virtually using web-based technology. Collaboration skills are taught and practiced in the weekly laboratory sessions and then utilized by team members from their home computers and/or local school facilities. Participating districts include Hartford, East Hartford, Manchester, South Windsor, Glastonbury, Regional District 8, Bolton, Vernon, and Ellington—a cross section of communities that include urban, suburban, and rural community school districts.

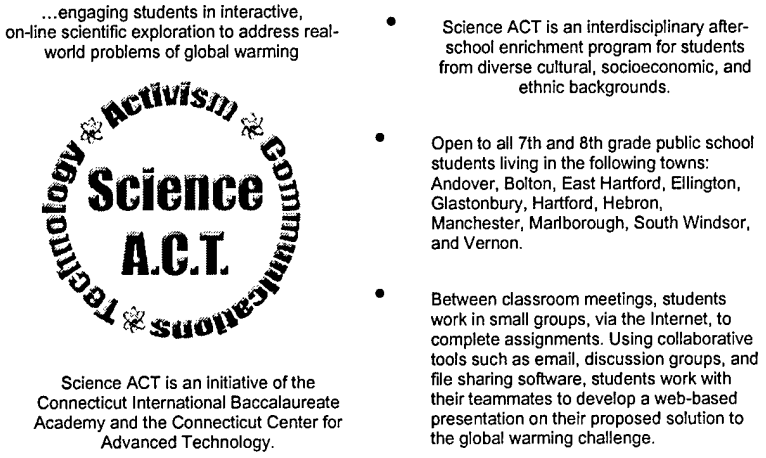

Figure 4. Science A.C.T. – Activism, Communications, & Technology

c. Community College Programs-Regional Center for Next Generation Manufacturing

Community colleges provide a critical element in the technological and economic strength of our nation. They are readily accessible to both new and continuing students, are focused on the student's success, are flexible with regard to educational delivery systems and embrace teachers from traditional academic as well as business and industry experience backgrounds.

CCAT, in partnership with regional community college faculty, identified opportunities for collaboration. To date, the most important is the development of an educational infrastructure that is more attuned to the competitive environment that our manufacturing companies are facing. To this end we identified the needs of industrial companies and workers and the characteristics of a more effective educational system to address them. The three industrial sectors identified for initial focus are:

- aerospace-a mature industry important to national security
- fuel cells-an emerging industry of importance to our economy
- medical devices-an opportunity to use aerospace capability in new markets

In addition, three technologies were selected for curriculum development.

- Precision machining-a capability critical to many industrial sectors
- Laser applications-a rapidly developing technology of broad applicability
- Nanotechnology-an emerging technology that must be clarified for use

This program concept was adopted by Connecticut's Community College System via their College of Technology (CoT) and has resulted in the award, by the National Science Foundation, to the CoT of a four year grant to establish the "Regional Center for Next Generation Manufacturing" The approach to establishing this center includes the following key goals:

Goal One: Implement a web-based, collaborative course delivery system that increases the flexibility and accessibility of advanced manufacturing education.

-Using blended learning best practices this will be tailored to the unique knowledge and experience based needs of those working in advanced manufacturing.

Goal Two: Develop and implement a curriculum pathway for careers in next generation manufacturing within the community colleges.

-A core curriculum that will include specific courses essential to manufacturing will assure a solid foundation to enable multiple career pathways

- Focused curriculum electives will be provided to assure employable skills

Goal Three: Respond to industry needs for well-prepared technicians in manufacturing (and development and service).

-Continuous updating of industry needs will be occur via collaboration with industrial companies and organizations

-Industry based courses will be integrated into the curriculum to assure concurrence with the most advanced practices and equipment

Goal Four: Upgrade the skills and knowledge of two-year college faculty and secondary school teachers in both vocational-technical and comprehensive high schools.

-Faculty will be provided with opportunities for externships in industry

-Supportive educational experiences will be provided and curriculum aids developed for both community college and high school use.

Goal Five: Support ongoing career pathways in next generation manufacturing.

-A community college system wide infrastructure will be created that informs students of opportunities in career paths, provides information regarding new courses and new technologies available, and creates a network for workers to share information and experiences.

C. Concluding Comments

This program has culminated in the creation of the basis for establishing the Connecticut Center for Advanced Technology. Through CCAT's formation we will assure that Connecticut's regional capabilities, critical to our nation's defense, can be strengthened. In addition, we will have the needed focus to participate effectively in major national initiatives that are essential to US global economic competitiveness. Collaboration between industry, academia and government will provide the basis for action in three areas:

- Technology Transition: Via the establishment of a Technology Center with its capabilities, global connectivity and core competence in technology transition and innovation.
- Enterprise Formation: Via the creation of an Innovation Center that incubates new enterprises critical to the process of "continuous industrial regeneration"
- Education: Via a Center focused on strengthening the dynamic role of "Innovation and Enterprise" in engaging and exciting students to develop careers in technology and Next Generation Manufacturing.

Consultant, Advisory & Transitions Functions

Dr. Mathieu has continued work with NAWSTC on projects related to the role of shared cognition in team and MTS systems.

New Discoveries, inventions, or patent disclosures

None

Honors/Awards

Dr Prewo was awarded the American Ceramic Society James Mueller Award for 2003

Personnel Supported

The following personnel were supported in full or in part in the past year.

University/UConn

Dr. John Mathieu, Co-principal Investigator, University of Connecticut School of Business

Attny William R. Breetz, Co-principal Investigator, University of Connecticut School of Law

CCAT

- Mr Fred Andrews regarding new enterprise creation
- Battelle Technology Partnership Practice-technology and industrial capabilities assessment
- Attorney William Breetz-contracts and intellectual property law
- Ms Ann Brickley-education and curriculum development
- Computer Central Inc-computer and IT support
- Dr Anthony Dennis-aerospace and structures
- Dr George Foyt- photonics and fuel cells
- Goldin Associates, Inc-aerospace supply chain technology
- Gordon Educational Technologies Inc-for K-12 and community college curriculum development
- Mr Guy Hatch-business incubation and fuel cell industry
- Innovatech LLC-technology, education and business incubation
- Mr Joseph King-clean energy technologies and fuel cells
- Mr Ronald Lehrach-aerospace technology
- Ms Stephanie Nicholas-student intern
- Karl M. Prewo-technology, education and business incubation
- Mr Anton Rick-Ossen-student intern
- TEaMS Company-technology and education programs development
- Mr William Secord-in K-12 education and curriculum development
- TechLinx LLC-aerospace technology and business development
- The Biomedical Engineering Alliance & Connection-BEACON-for biomedical applications and Homeland Security Seminar development
- University of Hartford, Engineering Applications Center-for laser applications

Related Publications / Presentations

Articles & Chapters

Marks, M. A., DeChurch, L. A., Mathieu, J. E., Panzer, F. J. & Alonso, A. A. (In Press). Teamwork in Multi-Team Systems. Journal of Applied Psychology

Mathieu, J. E., Cobb, M. A., Marks, M. A., Zaccaro, S. J. & Marsh, S. (2004). Multi-team ACES: A research platform for studying multi-team systems. In S. G. Schiflett, L. R. Elliott, E. Salas & M. Coovert, Eds.). Scaled worlds: Development, Validation and Applications. Burlington, VT: Ashgate. (297-315).

Mathieu, J. E., Marks, M. A., & Zaccaro, S. J. (2004). Using scaled worlds to study multi-team systems. In S. G. Schiflett, L. R. Elliott, E. Salas & M. Coovert, Eds.). Scaled worlds: Development, Validation and Applications. Burlington, VT: Ashgate. (279-296).

Manuscripts Under Review

Cobb, M. G., Mathieu, J. E. & Marks, M. A. (under second review). The Impact of Training and Environmental Complexity on the Effectiveness of Multi-Team Systems. Journal of Applied Psychology

Marks, M. A. & DeChurch, L. A. (under second review). Teams Leading Teams: An Experimental Investigation of Leadership in Multi-Team Systems. Journal of Applied Psychology

Presentations

Investigations of Multi-Team Systems (2003). John Mathieu (Chair). A symposium presented at the annual meeting of the Society for Industrial/Organizational Psychology, Orlando, FL. (April).

> *The Impact of Training and Environmental Complexity on the Effectiveness of Multi-Team Systems (Glenn Cobb, USAF)*
>
> *Importance of Goal Hierarchies and Teamwork Processes for Multi-Team Effectiveness (Michelle Marks, GMU)*
>
> *Growing Skills for Success in Multi-Team Systems: The Effects of Different Forms of Training Feedback (Andrea Rittman, GMU)*
>
> *Teams Leading Teams: An Experimental Investigation of Leadership in Multi-Team Systems (Leslie DeChurch, FIU)*

Rittman, A., Orvis, K., & Zaccaro, S. J. (2003). Interaction of leader and team affective processes contributing to team effectiveness. Paper presented at the 18th annual meeting of the Society for Industrial and Organizational Psychology, April 2003, Orlando, Fl.

Prewo, K. M. (2003). The Connecticut Center for Advanced Technology Program. Paper Presented at the Sources of Innovation seminar, Sponsored by the Connecticut Technology Council, June 19.

Prewo, K. M. (2003). Ceramic Matrix Composites, The 2003 American Ceramic Society James Mueller Lecture, at the 27th International Conference on Advanced Ceramics and Composites

Conferences and Workshops Organized

The Connecticut Fuel Cell Challenge-Business, Technology and Markets, Workshop for Industry, Academia and Government held at CT State Capital, Hartford CT, March 7, 2003

Public Health Preparedness and Response to Homeland Security-Information Technology Needs, Workshop held at Rensselaer at Hartford, Hartford, CT. (March 15, 2003).

The Use of Point Cloud Data Sets for Metrology and Reverse Engineering, Workshop held at CCAT, East Hartford, Ct, October 21, 2003

Conference on Structural Optimization Methods and Technology for Innovative and Profitable Product Design and Measurement, Conference held at Manchester Community College, Manchester, CT March 30, 2004

Laser Microfabrication-Fundamentals and Applications, Workshop held at University of Hartford, Hartford, CT, May 7, 2004

AFOSR Technical Reports

Cobb, M. G., Mathieu, J. E. & Marks, M. A. (2003). The Impact of Training and Environmental Complexity on the Effectiveness of Multi-Team Systems.

Marks, M. A., DeChurch, L. A., Mathieu, J. E., Panzer, F. J. & Alonso, A. A. (2003). Teamwork in Multi-Team Systems.

DeChurch, L. A. & Marks, M. A. (2004). Teams leading teams: Examining the role of leadership in multi-team systems.

Theses / Dissertations

DeChurch, L. A. (October2002). Teams leading teams: Examining the role of leadership in multi-team systems. Doctoral Dissertation, Florida International University.

Panzer, F. J. (January, 2003). The Influence of Gender and Ethnic Diversity on Team Effectiveness. Doctoral Dissertation, Florida International University.